



United States Department of the Interior

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March 1, 2017

In reply refer to:

AESO/SE

002EAAZ00-2012-F-0167-R1

Mr. Neil Bosworth, Forest Supervisor
Tonto National Forest
2324 East McDowell Road
Phoenix, Arizona 85006

Re: Reinitiation of the Haigler Creek Aquatic Habitat Restoration Project

Dear Mr. Bosworth:

Thank you for your request for formal consultation with the U.S. Fish and Wildlife Service (FWS) pursuant to section 7 of the **Endangered Species Act** of 1973 (16 U.S.C. § 1531-1544), as amended (Act). Your November 22, 2016, request and supplemental information was received by us on December 16, 2016. At issue are impacts that may result from the Forest Service authorizing the Arizona Game and Fish Department (AGFD) to conduct stream channel habitat restoration activities within Haigler Creek on the Pleasant Valley Ranger District in Gila County, Arizona.

You concluded that the proposed project “may affect and is likely to adversely affect” the threatened narrow-headed gartersnake (*Thamnophis rufipunctatus*) and its proposed critical habitat. You also determined that the action would have “no effect” on the threatened Chiricahua leopard frog (*Lithobates chiricahuensis*) and its designated critical habitat, the proposed threatened headwater chub (*Gila nigra*), and the threatened Mexican spotted owl (*Strix occidentalis lucida*) and its designated critical habitat. “No effect” determinations do not require our review and are not addressed further.

This project was initially proposed as the Canyon Creek and Haigler Creek Aquatic Habitat Enhancement Project with our concurrence provided for the Mexican spotted owl and its critical habitat on May 30, 2012 (22410-2012-F-0167). Due to funding constraints at that time, work on Haigler Creek was not started. With funding obtained, the project is being re-initiated to address effects to the narrow-headed gartersnake following our final listing decision in 2014 (79 FR 38677) and proposed rule for critical habitat in 2013 (78 FR 41550).

This biological and conference opinion is based on information provided in the August 2016, biological assessment (BA), construction specification drawings by Natural Channel Design (NCD 2015), the site assessment and design reports for Haigler Creek (NCD 2010a, 2010b), additional project information provided by email, telephone conversations, and other sources of information. Literature cited in this biological and conference opinion is not a complete bibliography of all literature available on the species of concern and its effects, or on other subjects considered in this opinion. A complete record of this consultation is on file at this office.

Consultation History

November 28, 2016: We received the draft biological assessment and request for formal consultation.

December 16, 2016: We received supplemental information to the biological assessment.

January 4, 2017: We received Attachment A: Natural Channel Design construction specification drawings.

January 5, 2017: We initiated formal consultation.

February 6, 2017: Our agencies agreed to change the timing of the project and discussed possible conservation measures for the narrow-headed gartersnake.

February 24, 2017: We informally sent a draft BO for your review in order to expedite the consultation.

February 28, 2017: We received comments on the draft BO.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Tonto National Forest (TNF), in partnership with the AGFD, proposes to restore and improve aquatic habitat and riparian health along Haigler Creek. The AGFD manages the fishery in Haigler Creek as a 'put and take' rainbow trout (*Onchorhynchus mykiss*) fishery, and their partnership intends to enhance the distribution of fish and increase recreational opportunities for anglers through stream habitat improvements. The purpose of this project is based on findings from several aquatic habitat assessments from 2009 (NCD 2010a, 2015) that found aquatic habitat conditions had deteriorated in the past decade as a result of severe flooding caused, in part, by the loss of watershed vegetation during large wildfires, such as the 2002 Rodeo-Chediski Fire. Additionally, stream run habitat lacked depth and cover to hold fish, particularly in the reaches surrounding the Haigler Canyon and Alderwood Campgrounds where heavy recreational use is concentrated (NCD 2010a). The project was designed in conformance with the Tonto National Forest's Land and Resource Management Plan and other federal and state laws, policies, and direction applicable to the resources present on the Forest (TNF 2016).

The proposed project will be conducted at two segments of Haigler Creek that surround the two campgrounds. The first segment begins approximately one mile upstream of the Forest Road (FR) 200 crossing at Fisherman's Point and extends downstream approximately 0.5 miles to the beginning of private land below Haigler Canyon Campground. The second segment extends from the downstream boundary of a private holding through Alderwood Campground and is approximately 0.75 mile in length (Figure 1). The estimated stream length where enhancement features would be installed is 0.2 mile (project footprint); the overall stream length of the area that was assessed for habitat enhancements extends from the first reach to the end of the second reach, a total of 3.5 miles (Figure 2, project area). The project is expected to start between the months of April and May of 2017 and be completed within a one to two week period, depending on weather, followed by a 2-year period to accommodate the need for any adjustments to structures and vegetation regrowth.

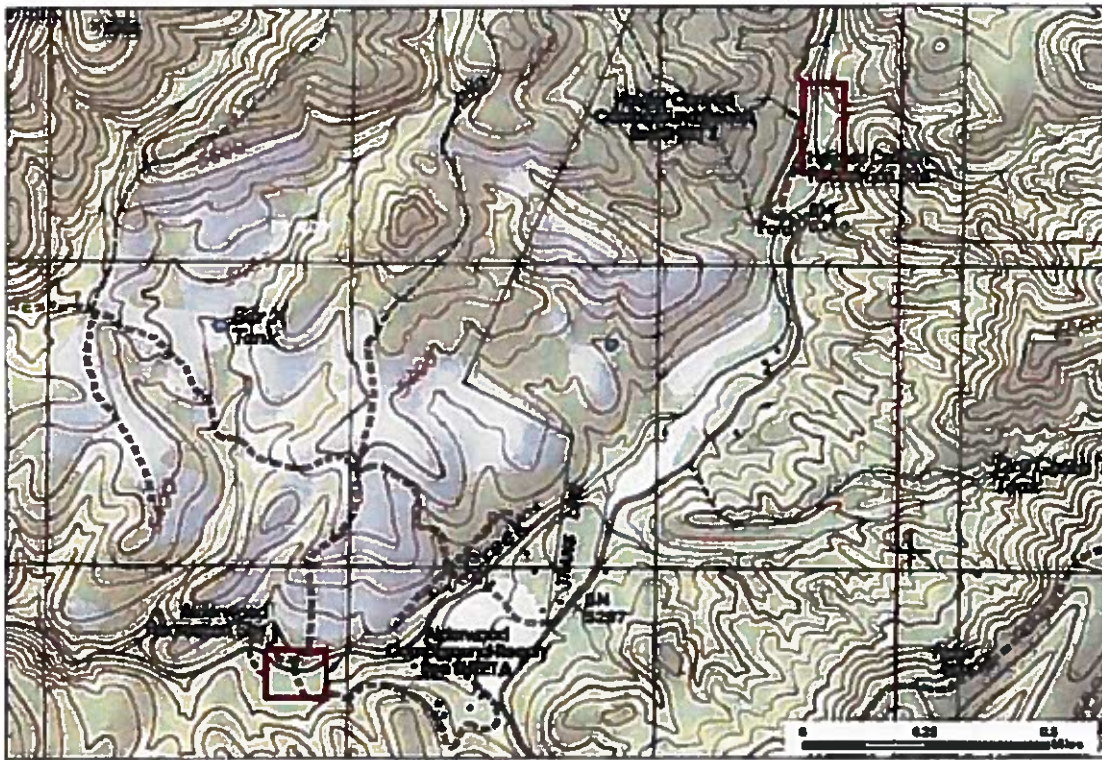


Figure 1: Project footprint where 0.2 mile of streamchannel restoration activities are planned.

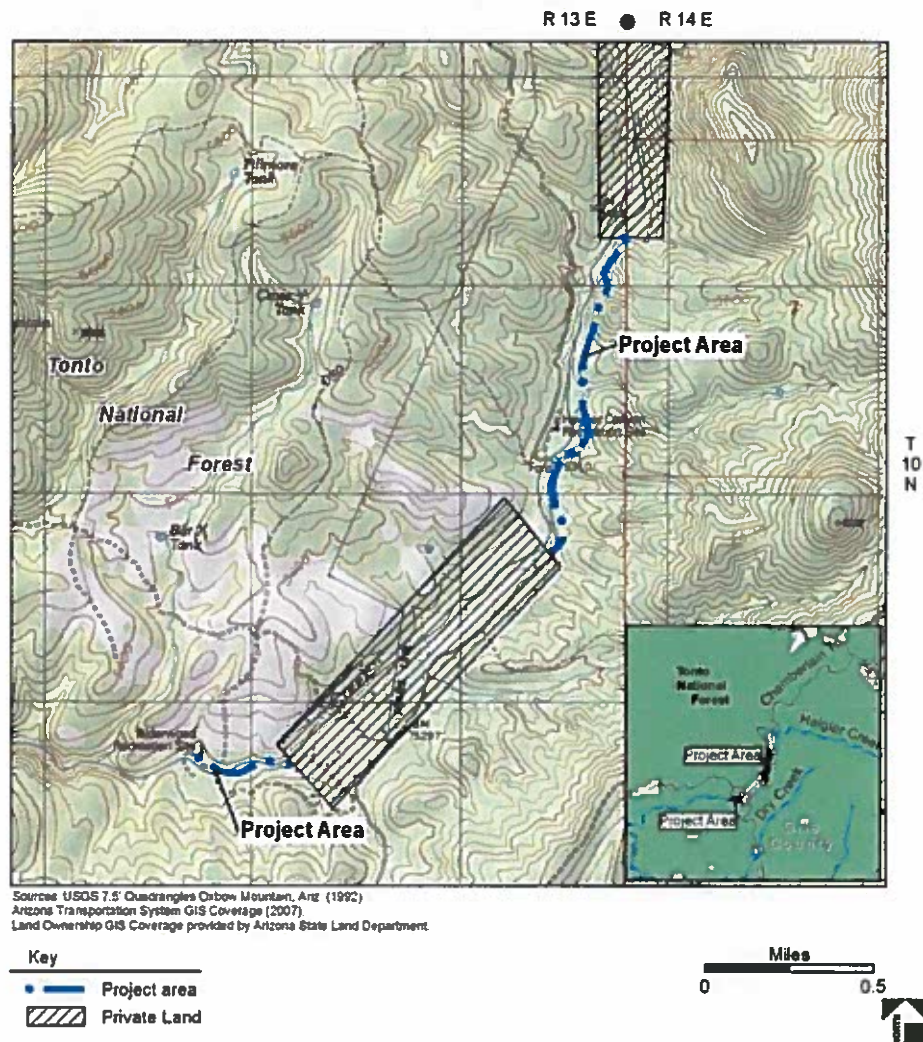


Figure 2: Map of the Project Area taken from the Tonto National Forest's August 2016 BA.

Construction and installation of several stream enhancement features would include: log and boulder cover structures, log barbs, access steps, boulder clusters, stepping stones, and log and rock anchors. Specific enhancements surrounding the Alderwood Campground reach include banksloping and revegetation combined with installation of a flood channel sill to prevent frequent flooding through the split channel. Log and boulder cover structures will be installed in the large pool to provide overhead cover for fish. Practices in the Haigler Canyon Campground reach include installation of two log barbs and a series of mid-stream boulder clusters to create cover. The ruptured gabion baskets will also be removed. Construction of the stream enhancements will be from rocks and logs mostly harvested from the project area. Smaller rock materials would be collected from inside the active channel or outside the floodplain. Larger rock materials for boulder clusters and materials for the rock sill will be procured from an off-site source and be approved by the TNF.

The use of heavy equipment, such as track hoe/excavator, backhoe and dump truck, is required for some of the work. Access to the site would be from existing Forest Service roads or trails that are wide enough to accommodate the equipment. Prior to their arrival on the job site, equipment will be cleaned and weed free to reduce any potential spread of invasive species between job sites. Use of heavy equipment for in-stream channel work will be kept to an absolute minimum with every effort to enter and exit the channel in locations where impacts would not result in new or additional stream bank instability. When stream crossings are no longer required, the area will be restored to its near original condition. Staging areas for equipment and stockpiles of excess material used for log covers would be located in existing disturbed or developed areas. In areas that cannot accommodate heavy equipment access, the enhancements would be constructed using hand tools.

Disturbed areas or unvegetated banks that will be excavated, used for access routes, and/or staging will be reseeded with a mixture of native grass seeds. Seeds will be weed-free (confirmed through laboratory tests from the supplier) and will be broadcast by hand. Erosion control fabric will also be applied in disturbed areas and areas being seeded to enhance germination. Willow (*Salix spp.*) poles will be planted to stabilize banks around disturbed areas where habitat enhancements are installed and to slow stream velocities in certain areas. Deer grass (*Muhlenbergia rigens*) plugs will be planted at the toe of the bank to protect it from erosion and provide overhead cover for fish (NCD 2010b).

Best Management Practices and Conservation Measures

The TNF proposed the following best management practices to protect the soil and water resources within the project areas and reduce construction related impacts to the watershed and biological resources.

- Guidelines for felling and using ponderosa pine trees:
 - When possible, trees that have fallen naturally and are still suitable for use would be used instead of felling living trees;
 - No trees greater than 18 inches in diameter at breast height (dbh) would be felled (larger trees can be used if they fell naturally);
 - Tree removal would focus on trees that are suppressed or subordinate in growth form and/ or diseased, when possible;
 - Only dead, standing trees and those used for the project are allowed to be felled. No Douglas fir or riparian obligate trees would be felled;
 - Slash would be lopped and scattered in such a manner that no slash pile is over 3 feet high and is in contact with living trees. Slash would be used to cover disturbed areas when possible;
 - No trees would be felled from a goshawk post fledging area. No trees with a raptor nest that has been active in the past year would be felled.

- Soil raking, distributing slash from felled trees, and replacing ground litter would be used to return the terrain to a natural condition immediately after ground disturbing activities such as, but not limited to:
 - Heavy equipment use--trucks, trailers, tractors, back hoes, front end loaders, etc.;
 - Skid marks (drag marks) caused by dragging felled trees into place;
 - Divots caused by removing boulders from the uplands and moving into place; and
 - Any other ground disturbing activities associated with securing logs or boulders into place.
- Willow and cottonwood pole cuttings would be taken during the dormant season; after leaf fall and before bud burst.
- No more than two-thirds of the willow or cottonwood pole source tree would be harvested.
- Project related construction activities would only occur between the months of April and May when narrow-headed gartersnakes are surface active and possibly able to avoid construction activities.
- Construction of enhancement features within the active channel would not occur during high flows such as during heavy local storms.
- A Forest or AGFD biologist will be on site during heavy equipment construction activities to attempt to protect narrow-headed gartersnakes and/or key habitat features during the construction.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR § 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment.

The overall action area length is a 3.5 mile section of Haigler Creek that begins above the Haigler Canyon Campground at Fisherman's Point and extends to 1 mile downstream of Alderwood Campground. The action area includes the 3.5 mile project area of Haigler Creek where activities are planned, including the 0.2 mile project footprint. The action area is larger than the project footprint to address sediment from construction activities that may be transported downstream during project implementation or during spring rainstorms. The width of the action area extends up to 100 feet from the active bankline and/or within a 100-foot radius from the center of the enhancement feature to account for any material collected within these areas that may impact the species and its habitat from ground disturbing actions. The area of impact however, may extend beyond 100 feet to include access routes from existing adjacent roads to the creek and staging areas.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components: (1) the *Status of the Species*, which evaluates the narrow-headed gartersnake range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the narrow-headed gartersnake in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the narrow-headed gartersnake; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The jeopardy analysis in this Biological Opinion considers the range-wide survival and recovery needs of the species and the role of the action area in its survival and recovery as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Conference Opinion relies on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. In accordance with policy and regulation, the adverse modification analysis in this Conference Opinion relies on four components: 1) the Status of Critical Habitat, which evaluates the range-wide condition of proposed critical habitat for the narrow-headed gartersnake in terms of physical and biological features, the factors responsible for that condition, and the intended value of the critical habitat for survival and recovery of the species; 2) the Environmental Baseline, which evaluates the condition of the proposed critical habitat in the action area, the factors responsible for that condition, and the value of the proposed critical habitat for survival and recovery of the species in the action area; 3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the physical and biological features and how that will influence the value of affected proposed critical habitat units for survival and recovery of the species; and 4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the physical and biological features and how that will influence the value of affected proposed critical habitat units for survival and recovery of the species.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the species' proposed critical habitat are evaluated in the context of the range-wide condition of the proposed critical habitat, taking into account any cumulative effects, to

determine if the proposed critical habitat range-wide would remain functional (or would not preclude or significantly delay the current ability for the physical and biological features to be functionally established in areas of currently unsuitable but capable habitat) such that the value of proposed critical habitat for the conservation of the species is not appreciably diminished.

STATUS OF THE SPECIES AND CRITICAL HABITAT

Narrow-headed Gartersnake

Legal Status

The narrow-headed gartersnake was listed as threatened on July 8, 2014 (79 FR 38678). Critical habitat was proposed on July 10, 2013 (78 FR 41550) and a final critical habitat rule is expected in the future.

Physical Description

The narrow-headed gartersnake is a small to medium-sized gartersnake with a maximum total length of 44 inches (in) (Painter and Hibbitts 1996). Its eyes are set high on its unusually elongated head that narrows to the snout; and it lacks striping on the dorsum (top) and sides, which distinguishes its appearance from other gartersnake species with which it could co-occur (Rosen and Schwalbe 1988). The base color is usually tan or grey-brown (but may darken) with conspicuous brown, black, or reddish spots that become indistinct towards the tail (Rosen and Schwalbe 1988; Boundy 1994). The scales are keeled. Degenhardt *et al.* (1996), Rossman *et al.* (1996), and Ernst and Ernst (2003) further describe the species.

Habitat and Natural History

The narrow-headed gartersnake is distributed across the Mogollon Rim of Arizona and New Mexico, at elevations from approximately 2,300 to 8,000 feet (ft). The species inhabits Petran Montane Conifer Forest, Great Basin Conifer Woodland, Interior Chaparral, and Arizona Upland Sonoran Desertscrub communities (Rosen and Schwalbe 1988; Brennan and Holycross 2006). The species is widely considered to be one of the most aquatic of the gartersnakes (Drummond and Marcias Garcia 1983; Rossman *et al.* 1996). It is strongly associated with clear, rocky streams, using predominantly pool and riffle habitat that includes cobbles and boulders (Rosen and Schwalbe 1988; Degenhardt *et al.* 1996; Rossman *et al.* 1996; Nowak and Santana-Bendix 2002; Ernst and Ernst 2003). Narrow-headed gartersnakes have also been observed using reservoir shoreline habitat in New Mexico (Flehart 1967; Rossman *et al.* 1996, Hellekson 2012b, pers. comm.). Despite the reputation of being highly aquatic, narrow-headed gartersnakes found in water represented less than 10 percent of total observations according to a multi-year telemetry study in New Mexico, with slightly more females found in water compared to males (Jennings and Christman 2012). These data suggest that this species may spend a relatively small percentage of its time in the water, but compared to other native gartersnakes, it is still the most aquatic.

Narrow-headed gartersnakes also use terrestrial, upland habitat during periods of cold-season dormancy, for gestation of young in pregnant females, for bask to aid digestion and for healing from injury or illness, and to escape flood events. Nowak (2006) found narrow-headed gartersnakes used upland habitat that was 328 ft away from the stream during early fall and spring months and may strongly associate with boulders in the floodplain during summer months. During cold-season dormancy periods, narrow-headed gartersnakes may use upland habitat up to 656 ft or farther out of the floodplain (Nowak 2006).

Narrow-headed gartersnakes eat fish primarily (Rosen and Schwalbe 1988; Degenhardt *et al.* 1996; Rossman *et al.* 1996; Nowak and Santana-Bendix 2002; Nowak 2006) and are considered specialists in this regard. This species is an underwater ambush hunter that is believed to be heavily dependent on visual cues when foraging (de Queiroz 2003; Hibbitts and Fitzgerald 2005). Therefore, sediment and turbidity levels within the water column may affect foraging success. Native fish species considered as prey for the narrow-headed gartersnake include Sonora sucker (*Catostomus insignis*), desert sucker (*C. clarki*), speckled dace (*Rhinichthys osculus*), roundtail chub (*Gila robusta*), Gila chub (*Gila intermedia*), and headwater chub (*Gila nigra*) (Rosen and Schwalbe 1988; Degenhardt *et al.* 1996). Nonnative predatory fish species in their fingerling size classes are also used as prey by narrow-headed gartersnakes, including brown trout (*Salmo trutta*) (Rosen and Schwalbe 1988; Nowak and Santana-Bendix 2002; Nowak 2006), green sunfish (*Lepomis cyanellus*) (Flehart 1967), smallmouth bass (*Micropterus dolomieu*) (M. Lopez, 2010, pers. comm.), and rock bass (*Ambloplites rupestris*) (Wilcox 2015). Reports suggest that brown trout are consumed more frequently than smallmouth bass. Nonnative fish with spiny dorsal fins are not generally considered suitable prey items due to the risk of injury to the gartersnake during ingestion and because of where they tend to occur in the water column (Nowak and Santana-Bendix 2002).

Native predators of the narrow-headed gartersnake include birds of prey, such as black-hawks (Etzel *et al.* 2014), other snakes such as regal ring-necked snakes (Brennan *et al.* 2009), wading birds, mergansers, belted kingfishers, raccoons (Rosen and Schwalbe 1988), and possibly other generalist mammalian predators. Historically, large, highly predatory native fish species such as Colorado pikeminnow may have preyed upon narrow-headed gartersnakes where the species co-occurred. Native chubs (*Gila* spp.) in their adult size class may also prey on neonatal gartersnakes.

Sexual maturity in narrow-headed gartersnakes occurs at 2.5 years of age in males and at 2 years of age in females (Degenhardt *et al.* 1996). Narrow-headed gartersnakes are viviparous. Narrow-headed gartersnakes breed annually and females give birth from late July into early August, perhaps earlier at lower elevations (Rosen and Schwalbe 1988). Longevity in this species may be as long as 10 years in the wild (Rosen and Schwalbe 1988).

Historical Distribution

The historical distribution of the narrow-headed gartersnake ranged across the Mogollon Rim and along associated perennial stream drainages from central and eastern Arizona, southeast to southwestern New Mexico at elevations ranging from 2,300 to 8,000 ft (Rosen and Schwalbe 1988; Rossman *et al.* 1996; Holycross *et al.* 2006). The species was historically distributed in headwater streams of the Gila River subbasin that drain the Mogollon Rim and White Mountains in Arizona, and the Gila Wilderness in New Mexico. Major subbasins in its historical

distribution included the Salt and Verde River subbasins in Arizona, and the San Francisco and Gila River subbasins in New Mexico (Holycross *et al.* 2006). Despite the 2,300 ft low elevation record for narrow-headed gartersnakes at Horseshoe Bend along the Salt River (Rosen and Schwalbe 1988, Appendix II), Holycross *et al.* (2006) suspect the species was likely not historically present in the lowest reaches of the Salt, Verde, and Gila Rivers, even where perennial flow persists. Numerous records for the narrow-headed gartersnake (through 1996) in Arizona are maintained in the AGFD's Heritage Database.

Current Distribution and Population Status

In 2011, the only remaining narrow-headed gartersnake populations where the species could reliably be found were located at: (1) Whitewater Creek (NM), (2) Tularosa River (NM), (3) Diamond Creek (NM), (4) Middle Fork Gila River (NM), and (5) Oak Creek Canyon (AZ). However, in 2012, New Mexico's largest wildfire in state history occurred, the Whitewater-Baldy Complex Fire. Narrow-headed gartersnake populations in Whitewater Creek and the Middle Fork Gila River were significantly affected by ash and sediment flows and the resultant fish kills which decimated the gartersnake's prey base. The narrow-headed gartersnake population in the Middle Fork Gila River appears to be stabilizing with the return of native fish (Christman 2016a), but the Whitewater creek population remains at very low population density or may be extirpated, based on sampling results from 2015 (Christman 2016a). However, a robust and long-term sampling program is required to consider the species officially "extirpated" from an area and would be considered a temporary state, depending on its ecological condition. Based on the most recent capture rates and survey results from Diamond Creek, New Mexico, (GCWG 2016) the crayfish population has reached a high density and the narrow-headed gartersnake population may be in a potentially sharp decline. The 2014 Slide Fire which occurred within the Oak Creek and West Fork Oak Creek watershed, posed a unique threat to the resident narrow-headed gartersnake population but recent surveys (GCWG 2016) suggest the fish community may not have been as severely affected as originally thought. Nowak (2006, p. 10) demonstrates population reductions in narrow-headed gartersnakes and fewer snakes per person-search hour effort, as compared to that of Rosen and Schwalbe (1988, Appendix II) in this same area; a trend which may be continuing according to VES detection rates at repeated transects in Oak Creek and West Fork Oak Creek (Nowak 2016b).

As of 2016, as many as 41 of 51 (80 percent) known narrow-headed populations may exist at low densities and could be threatened with extirpation (Table 1). Another four populations may already be extirpated.

Table 1: Current Population Status of the Narrow-headed Gartersnake.

Current Population Status of the Narrow-headed Gartersnake						
Row	Location	Last Record	Suitable Physical Habitat Present	Native Prey Species Present	Harmful Nonnative Species Present	Predicted Population Status
1	West Fork Gila River (NM)	2014	Yes	Yes	Yes	Likely low density
2	Middle Fork Gila River (NM)	2016	Yes	Yes	Yes	Likely viable
3	East Fork Gila River (NM)	2006	Yes	Yes	Yes	Likely low density
4	Gila River (AZ, NM)	2009	Yes	Yes	Yes	Likely low density
5	Snow Creek/Snow Lake (NM)	2012	Yes	No	Yes	Likely low density
6	Gilita Creek (NM)	2009	Yes	Yes	No	Likely low density
7	Iron Creek (NM)	2009	Yes	Yes	No	Likely low density
8	Little Creek (NM)	2010	Yes	Possible	Yes	Likely low density
9	Turkey Creek (NM)	1985	Yes	Yes	Possible	Likely low density
10	Beaver Creek (NM)	1949	Yes	Possible	Yes	Likely extirpated
11	Black Canyon (NM)	2010	Yes	Yes	Yes	Likely low density
12	Taylor Creek/Wall Lake (NM)	1960	Yes	No	Yes	Likely extirpated
13	Diamond Creek (NM)	2016	Yes	Yes	Yes	Likely viable
14	Tularosa River (NM)	2016	Yes	Yes	Yes	Likely viable
15	Whitewater Creek (NM)	2012	Yes	Yes	Yes	Likely low density
16	San Francisco River (NM)	2011	Yes	Yes	Yes	Likely low density
17	Negrito Creek (NM)	1977	Yes	Yes	Yes	Likely extirpated
18	South Fork Negrito Creek (NM)	2010	Yes	Possible	Yes	Likely low density
19	Blue River (AZ)	2016	Yes	Yes	Yes	Likely low density
20	Dry Blue Creek (AZ, NM)	2010	Yes	Possible	Yes	Likely low density
21	Campbell Blue Creek (AZ, NM)	2016	Yes	Possible	Yes	Likely low density
22	Coleman Creek (AZ)	1989	Yes	Possible	No	Likely low density
23	Saliz Creek (NM)	2015	Yes	Possible	Yes	Likely low density
24	Eagle Creek (AZ)	2013	Yes	Possible	Yes	Likely low density
25	Black River (AZ)	2015	Yes	Yes	Yes	Likely low density
26	East Fork Black River (AZ)	2004	Yes	Possible	Yes	Likely low density
27	West Fork Black River (AZ)	1991	Yes	Yes	Possible	Likely low density

Current Population Status of the Narrow-headed Gartersnake

28	Fish Creek (Tributary to East Fork Black River; AZ)	2004	Yes	Yes	Possible	Likely viable
29	Bear Wallow Creek (Tributary to Black River)	2003	Yes	Yes	Possible	Likely viable
30	North Fork Bear Wallow Creek (Tributary to Black River)	2004	Yes	Yes	Possible	Likely viable
31	Reservation Creek (Tributary to Black River)	2016	Yes	Yes	Yes	Likely low density
32	White River (AZ)	1967	Yes	Possible	Possible	Likely low density
33	East Fork White River (AZ)	1964	Yes	Possible	Possible	Likely low density
34	North Fork White River (AZ)	1986	Yes	Yes	Possible	Likely low density
35	Diamond Creek (AZ)	1986	Yes	Possible	Possible	Likely low density
36	Tonto Creek (tributary to Big Bonita Creek, AZ)	1915	Yes	Possible	Possible	Likely low density
37	Canyon Creek (AZ)	2016	Yes	Yes	Yes	Likely low density
38	Ash Creek (Tributary to Salt River)	2016	Yes	Yes	No	Likely low density
39	Upper Salt River (AZ)	1985	Yes	Yes	Yes	Likely low density
40	Cibique Creek (AZ)	1991	Yes	Yes	Possible	Likely low density
41	Carrizo Creek (AZ)	1997	Yes	Yes	Possible	Likely low density
42	Big Bonito Creek (AZ)	1986	Yes	Yes	Yes	Likely low density
43	Haigler Creek (AZ)	2014	Yes	Yes	Yes	Likely low density
44	Houston Creek (AZ)	2005	Yes	Yes	Yes	Likely low density
45	Tonto Creek (tributary to Salt River, AZ)	2005	Yes	Yes	Yes	Likely low density
46	Christopher Creek	1993	Yes	Yes	Yes	Likely low density
47	Deer Creek (AZ)	1995	No	No	No	Likely extirpated
48	Upper Verde River (AZ)	2012	Yes	Yes	Yes	Likely low density
49	Oak Creek (AZ)	2016	Yes	No	No	Likely low density
50	West Fork Oak Creek (AZ)	2016	Yes	No	No	Likely low density
51	East Verde River (AZ)	1992	Yes	Yes	Yes	Likely low density

Notes: "Possible" means there were no conclusive data found. "Likely extirpated" means the last record for an area pre-dated 1980, and existing threats suggest the species is likely extirpated. "Likely low density" means there is a post-1980 record for the species, it is not reliably found with minimal to moderate survey effort, and threats exist which suggest the population may be low density or could be extirpated, but there is insufficient evidence to support extirpation. "Likely viable" means that the species is reliably found with minimal to moderate survey effort, and the population is generally considered to be somewhat resilient.

Factors Associated with Population Declines and Range Retractions

The best available commercial and scientific information confirms that harmful nonnative species such as bass (*Micropterus* sp.), flathead catfish (*Pylodictis* sp.), channel catfish (*Ictalurus* sp.), bullheads (*Ameiurus* sp.), sunfish (*Lepomis* sp.), crappie (*Pomoxis* sp.), brown trout (*Salmo trutta*), American bullfrogs (*Lithobates catesbeiana*), crayfish (northern (virile) crayfish (*Orconectes virilis*) and red swamp crayfish (*Procambarus clarkii*) are the most significant threat to narrow-headed gartersnakes and their prey bases, and have had a profound role in their rangewide decline (79 FR 38678). For example, in 2014, Timmons *et al.* (2015, entire) conducted fish surveys at 65 different sites within the Gila River basin and concluded that at approximately 46 of the sites sampled, nonnative fish were a primary threat to the native fish community; often followed by drought or crayfish. Complex ecological interactions between these harmful nonnative species and the native aquatic community have resulted in direct predation on gartersnakes; shifts in biotic community structure from largely native to largely nonnative; and competition for a diminished gartersnake prey base that can ultimately result in the injury, starvation, or death of individual narrow-headed gartersnakes followed by reduced recruitment within populations, subsequent population declines, and ultimately local and regional extirpations. The native fish communities that serve as a prey base for narrow-headed gartersnakes have been severely affected by harmful nonnative species such that native aquatic ecosystems are on the verge of collapse in many regions, as documented by multiple listings of native fish species of the Southwestern United States and by a large body of literature over several decades (Meffe 1985; Propst *et al.* 1986; 1988; 2009; Rosen and Schwalbe 1988; Douglas *et al.* 1994; Degenhardt *et al.* 1996; Fernandez and Rosen 1996; Richter *et al.* 1997; Inman *et al.* 1998; Rinne *et al.* 1998; Nowak and Santana-Bendix 2002; Propst 2002; DFT 2003; 2004; Bonar *et al.* 2004; Rinne 2004; Clarkson *et al.* 2005; Fagan *et al.* 2005; Knapp 2005; Olden and Poff 2005; Turner 2007; Holycross *et al.* 2006; Brennan 2007; Propst *et al.* 2008; Brennan and Rosen 2009; Minckley and Marsh 2009; Pilger *et al.* 2010; Stefferud *et al.* 2011).

Activities that reduce flows or dewater habitat, such as dams and diversions (Ligon *et al.* 1995; Turner and List 2007), flood-control projects, and groundwater pumping (Stromberg *et al.* 1996; Rinne *et al.* 1998; Voeltz 2002; Haney *et al.* 2009; USGS 2013), seriously threaten the physical habitat of the gartersnakes and are second only to harmful nonnative species in their scope and magnitude of effect on the narrow-headed gartersnake because fish must have water to survive and without this prey base, narrow-headed gartersnakes will not persist. These structures alter the timing, duration, intensity, and frequency of flood events which favors harmful nonnative species and leads to shifts in entire fish communities (Rinne *et al.* 1998; 2005; Propst *et al.* 2008) which compounds their effect on narrow-headed gartersnake populations. Human population growth has resulted in increased water demands and exacerbated the magnitude and scope of these effects on narrow-headed gartersnake populations.

High intensity wildfires lead to excessive sedimentation and ash flows which can, in turn, result in sharp declines in fish communities downstream and even complete fish kills. In 2011 and 2012, both Arizona (2011 Wallow Fire) and New Mexico (2012 Whitewater-Baldy Complex Fire) experienced the largest wildfires in their respective State histories; indicative of the last decade that has been punctuated by wildfires of massive proportion. The 2011 Wallow Fire affected (to various degrees) approximately 540,000 acres of Apache-Sitgreaves National Forest, White Mountain Apache Indian Tribe, and San Carlos Apache Indian Reservation lands in

Apache, Navajo, Graham, and Greenlee counties in Arizona as well as Catron County, New Mexico (InciWeb 2011). The 2011 Wallow Fire impacted 97 percent of perennial streams in the Black River subbasin, 70 percent of perennial streams in the Gila River subbasin, and 78 percent of the San Francisco River subbasin and resulted in confirmed fish kills in each subbasin (Meyer 2011); each of these streams is known to support populations of narrow-headed gartersnakes.

Post-fire flooding with significant ash and sediment loads can result in significant declines, or even the collapse, of resident fish communities, which poses significant concern for the persistence of resident gartersnake populations in affected areas. Sedimentation can adversely affect fish populations used as prey by narrow-headed gartersnakes by: (1) Interfering with respiration; (2) reducing the effectiveness of fish's visually based hunting behaviors; and (3) filling in interstitial (spaces between cobbles, etc., on the stream floor) spaces of the substrate, which reduces reproduction and foraging success of fish (Wheeler *et al.* 2005). Siltation of the rocky interstitial spaces along stream bottoms decreases the dissolved oxygen content where fish lay their eggs, resulting in depressed recruitment of fish and a subsequent reduction in prey abundance for narrow-headed gartersnakes through the loss of prey microhabitat (Nowak and Santana-Bendix 2002). The underwater foraging ability of narrow-headed gartersnakes (de Queiroz 2003) is largely based on vision and is also directly compromised by excessive turbidity caused by sedimentation of water bodies. Suspended sediment in the water column may reduce the narrow-headed gartersnake's visual hunting efficiency from effects to water clarity, based on research conducted by de Queiroz (2003) that concluded the species relied heavily on visual cues during underwater striking behaviors.

The presence of adequate interstitial spaces along stream floors may be particularly important for narrow-headed gartersnakes. Hibbitts *et al.* (2009) reported the precipitous decline of narrow-headed gartersnakes in a formerly robust population in the San Francisco River at San Francisco Hot Springs from 1996 to 2004. The exact cause for this decline is uncertain, but the investigators suspected that a reduction in interstitial spaces along the stream floor from an apparent conglomerate, cementation process may have affected the narrow-headed gartersnake's ability to successfully anchor themselves to the stream bottom when seeking refuge or foraging for fish (Hibbitts *et al.* 2009). These circumstances would likely result in low predation success and eventually starvation.

Many other factors have contributed to the decline of the narrow-headed gartersnake, and in some cases, continue to present a significant threat to low-density populations through synergistic mechanisms, including: climate change and drought (IPCC 2007; Seager *et al.* 2007; Overpeck 2008); development and recreation within riparian corridors (Briggs 1996, Ernst and Zug 1996, Green 1997, Wheeler *et al.* 2005, Paradzick *et al.* 2006); indirect effects from fisheries management activities (Dawson and Kolar 2003, Carpenter and Terrell 2005, Holycross *et al.* 2006, Finlayson *et al.* 2010); road construction, use, and maintenance (Klauber 1956, Waters 1995, Shine *et al.* 2004, Ouren *et al.* 2007, Breininger *et al.* 2012); adverse human interactions with gartersnakes (Fleharty 1967, Green 1997, Nowak and Santana-Bendix 2002, Hibbitts and Fitzgerald 2009); environmental contaminants (Hopkins *et al.* 1999, Campbell *et al.* 2005, Rainwater *et al.* 2005, Wylie *et al.* 2009); and mortality from entanglement hazards such as erosion control products (Stuart *et al.* 2001, Barton and Kinkead 2005, Kapfer and Paloski 2011, Barragán-Ramírez and Ascencio-Arrayga 2013, NMDGF 2013).

For a detailed analysis on the status of and threats to the narrow-headed gartersnake, please review the proposed listing rule (78 FR 41500) which is incorporated herein by reference.

Proposed Critical Habitat

In July, 2013, (78 FR 41550) we proposed 6 units as critical habitat for the narrow-headed gartersnake. The six units we propose as critical habitat for the narrow-headed gartersnake are: (1) Upper Gila River Subbasin; (2) Middle Gila River Subbasin; (3) San Francisco River Subbasin; (4) Salt River Subbasin; (5) Tonto Creek Subbasin; and (6) Verde River Subbasin. All proposed critical habitat units are considered occupied.

The Tonto Creek Subbasin Unit is located southeast of Payson and northeast of the Phoenix metropolitan area, in Gila County. This Unit includes a total of 12,795 acres along 91 stream miles of proposed critical habitat within the Haigler Creek, Houston Creek, and Tonto Creek Subunits. The Haigler Creek Subunit contains approximately 3,037 acres along 21.8 stream miles from its confluence with Tonto Creek upstream to its origin at the east end of Naeglin Canyon. Of this amount, 2,831 acres are on Forest Service land (78 FR 41550).

The proposed primary constituent elements for the narrow-headed gartersnake are below.

(1) Stream habitat, which includes:

- a. Perennial or spatially intermittent streams with sand, cobble, and boulder substrate and low or moderate amounts of fine sediment and substrate embeddedness, and that possess appropriate amounts of pool, riffle, and run habitat to sustain native fish populations;
- b. A natural, unregulated flow regime that allows for periodic flooding or, if flows are modified or regulated, a flow regime that allows for adequate river functions, such as flows capable of processing sediment loads;
- c. Shoreline habitat with adequate organic and inorganic structural complexity (e.g., boulders, cobble bars, vegetation, and organic debris such as downed trees or logs, debris jams), with appropriate amounts of shrub- and sapling-sized plants to allow for thermoregulation, gestation, shelter, protection from predators, and foraging opportunities; and
- d. Aquatic habitat with no pollutants or, if pollutants are present, levels that do not affect survival of any age class of the narrow-headed gartersnake or the maintenance of prey populations.

(2) Adequate terrestrial space (600 feet) lateral extent to either side of bankfull stage) adjacent to designated stream systems with sufficient structural characteristics to support life-history functions such as gestation, immigration, emigration, and brumation.

(3) A prey base consisting of viable populations of native fish species or soft-rayed, nonnative fish species.

(4) An absence of nonnative fish species of the families Centrarchidae and Ictaluridae, bullfrogs (*Lithobates catesbeianus*), and/or crayfish (*Orconectes virilis*, *Procambarus clarki*, etc.), or occurrence of these nonnative species at low enough levels such that recruitment of narrow-headed gartersnakes and maintenance of viable native fish or soft-rayed, nonnative fish populations (prey) is still occurring.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions which are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Description of the Action Area

Haigler Creek is a perennial tributary of Tonto Creek with its headwaters originating below the Mogollon Rim in Naegelin Canyon. The majority of land surrounding Haigler Creek is managed by the TNF with the exception of two small private inholdings. The uplands are dominated by ponderosa pine; alder (*Alnus oblongifolia*) or Arizona sycamore (*Platanus wrightii*) tree species in the riparian zone. Cottonwood trees (*Populus spp.*) are found mainly near the Alderwood Campground (NCD 2010a). Desert false indigo (*Amorpha fruticosa*) is the abundant shrub in the overbank zone and deer grass (*Mulhenburgia rigens*) dominates the toe portion of the bank. Dense tree canopy prevents development of understory shrubs. The stream banks are generally well vegetated except for high traffic areas around the two campgrounds (TNF 2016).

The stream reaches in the action area are located in a narrow valley and range in elevation from approximately 5,000 feet near Alderwood Campground to 5,500 feet in upper Haigler Creek. The creek bed material ranges from a mixture of cobble/gravel, areas of large boulders, and short sections of bedrock. Natural Channel Design and AGFD walked both reaches in 2009 to assess habitat conditions. Generally, Haigler Creek is considered to be in satisfactory functioning condition (NCD 2010a). The information presented below summarizes their findings. Additional information is found in Natural Channel Design's Site Assessment Report for Haigler Creek (NCD 2010a).

Haigler Canyon Campground Reach

The first reach begins in an open riparian area above the Haigler Canyon Campground. There are a series of riffles and pools with longer runs in this reach of Haigler Creek. The pools generally provide good cover, and the riffles tend to be shallow with less holding habitat for large fish. The runs tend to be of similar depth and substrate over their entire length and are of low quality for fish because they lack hiding areas. The two major run habitats in this reach are located very near the campground, and trails to the stream indicate heavy fishing pressure and heavy foot traffic. The run habitat near areas of high angler use does not have adequate depth or cover to hold fish. The low water crossing at FR 200 serves as a grade control structure for the stream and the stream channel immediately upstream of the crossing is somewhat aggraded and

wider than other reaches. Below the crossing, deeper pools exist. The banks have been heavily trampled by foot traffic resulting in denuded stream banks and the ability for sediment to enter the stream. With exception of heavy foot traffic in several areas, the habitat is generally good. The final portion of this reach lacks large pools and cover that are beneficial to fish (NCD 2010a). The campground occurs in an active livestock allotment but is currently fenced to prohibit cattle from accessing the creek (TNF 2016).

Alderwood Campground Reach

The Alderwood Campground reach begins from the end of private land and extends 0.75 mile downstream. Dispersed camping had been allowed on both sides of the stream up until the early 2000s. The banks receive very high foot traffic from anglers and campers with some areas denuded of vegetation. This reach has significant bank erosion and channel realignment as a result of significant flooding in 2007-2008. Large downed trees appear to have clogged the channel during flooding and diverted flows across the flood plain. In the lower portion of the reach, base flows split into two separate channels for several hundred feet before rejoining as the valley floor narrows. There are several large cutbanks that are eroding along the original channel near the campground. Lack of sediment transport capacity in this reach has caused some aggradation of material and stream widening. Flooding has also created some new fish habitat in the form of undercut banks, overhanging roots, and scour pools. The long run habitat is relatively shallow with very little overhead cover while the area receives high fishing pressure and high foot traffic on the banks. The recreational area is within an active grazing allotment. In 2009, fencing had been installed along the streambanks to exclude cattle but there was evidence of streamside grazing during a site visit. The TNF visited Alderwood Campground in 2016 and observed that the fence was intact and no streamside grazing was evident.

Nonnative and native species have been documented in the action area. The nonnative species include reproducing populations of rainbow trout (*Onchorhynchus mykiss*) and brown trout (*Salmo trutta*), and a high density of crayfish (*Orconectes virilis*) (Goode and Parker 2015; NCD 2010a). Brown trout (*Salmo trutta*) were stocked successfully in 1991 in the upper reaches in Haigler Creek (NCD 2010a), and populations of both trout species now exist throughout the system (Goode and Parker 2015). Native fish species such as longfin dace (*Agosia chrysogaster*), desert sucker (*Catostomus clarki*), and speckled dace (*Rhynchithes osculus*) (Mosher *et al.* 2012; Vasey *et al.* 2012; Timmons *et al.* 2015) are found in riffle sections of the action area.

A. Status of the species and critical habitat within the action area

There are three unvouchered, but reliable, observational records of narrow-headed gartersnakes from upper Haigler Creek near the FS 200 road crossing in 2004 (Holycross *et al.* 2006). In 2008, surveys in Haigler Creek resulted in a photo voucher, with the hand-capture of an adult male narrow-headed gartersnake (Kern and Burger 2008). In 2014-2015, Goode and Parker (2015) conducted intensive visual encounter surveys and aquatic trapping during five trips to Haigler Creek. During their surveys in 2014, they captured three juvenile narrow-headed gartersnakes approximately 0.6 to 1.86 mile below Alderwood Campground (Goode and Parker 2015). In 2015, Goode and Parker conducted visual encounter surveys and aquatic trapping in upper Haigler Creek and below Alderwood Campground. No narrow-headed gartersnakes were

detected, including negative detections in areas they were observed in 2014. Observations of other gartersnake species were also lower than expected. Because the gartersnake has been observed below Alderwood Campground, there is the potential for individuals to be present during project implementation. Other than the 2004 detection, no narrow-headed gartersnakes have been documented in upper Haigler Creek. We believe the population status of the narrow-headed gartersnake in Haigler Creek is likely at low density (Table 1).

Overall, the Haigler Creek Subunit contains sufficient physical or biological features, including PCEs 1 (aquatic habitat characteristics), 2 (terrestrial habitat characteristics), and 3 (prey base), but PCE 4 (absence or low level of harmful nonnative species) is deficient. The portion of proposed critical habitat in the action area, based on the best available information also contains sufficient physical or biological features with the exception of PCE 4. Special management may be required to eliminate or reduce the population of brown trout and crayfish within the action area.

B. Factors affecting species environment and critical habitat within the action area

In general, the primary factors affecting the narrow-headed gartersnake within the action area are the presence and introduction of harmful nonnative aquatic species (brown trout and crayfish) that compete with and prey upon both the narrow-headed gartersnake and its native prey species, and the decline of the native fishes that are the gartersnake's primary prey. The headwater chub has declined in Haigler Creek and occurs, along with other native fish species used as prey, approximately 2.5 miles downstream of Alderwood Campground, outside of the action area. The decline of native fish species and the increase of nonnative species and crayfish have likely contributed to a decline in distribution and density of the gartersnake in the action area.

Other factors that may be affecting the gartersnake include heavy recreational use within its habitat. The Haigler Canyon and Alderwood Campgrounds are popular fishing sites. Recreational angling may have a variety of impacts including: 1) disturbance of riparian systems by walking through the area; 2) degradation of water quality from stream bank destabilization, wading, human waste, and trash, 3) introduction of angler debris (predominantly fishing line which is an entanglement hazard for wildlife); 4) inadvertent spread of pathogens, diseases, and invasive species by anglers, and 5) direct mortality to non-target aquatic species. Previously authorized dispersed camping along the banks has led to soil compaction and contributes to the general degradation of the riparian zone. Between 2002 and 2004, the TNF closed access to the riparian area from motorized vehicle use at both campgrounds and developed camping sites next to the road.

Impacts from the stocking of rainbow trout on the narrow-headed gartersnake and its prey species were analyzed under the AGFD's Statewide and Urban Fisheries Stocking Program for 2011-2021 BO (FWS file number 22410-2008-F-0486). The AGFD, FWS, and the Wildlife and Sport Fish Restoration Program developed a Conservation and Mitigation Program (CAMP) to reduce and offset impacts of the stocking program on listed species such as the narrow-headed gartersnake, which is a priority species for the program. Among the mandatory conservation measures for the narrow-headed gartersnake in CAMP, within 3 years the AGFD shall develop outreach material on gartersnakes to attempt to reduce the deliberate killing or injuring of gartersnakes by the public; inform the public about the capture, use, and proper disposal of live

bait species; and reduce or prevent inadvertent transport of nonnative species (sportfish, baitfish, other fish species, amphibians, invertebrates, and plants). Signs regarding not disturbing any observed narrow-headed gartersnakes are posted at Alderwood and Haigler Canyon Campgrounds for educational purposes, as are other materials to protect that area's natural resources.

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Effects to Narrow-headed Gartersnake

We anticipate that direct effects will occur to the narrow-headed gartersnake from construction activities occurring within the species habitat. During periods of cold-season dormancy (late winter to early spring), gartersnakes use upland areas and often hibernate under boulders, downed wood, debris, or rock clusters that may be removed and relocated near the stream channel for use as an enhancement structure. Depending on the start of the project (early April) and weather conditions, collection of these natural materials may potentially overlap with overwintering gartersnakes. During April or May (when the proposed action is planned to occur), it is more likely narrow-headed gartersnakes would be using these items as temporary cover sites, particularly boulders of various sizes. In either case, there is a potential for individuals to be unearthed or disturbed that could result in a flight response, possibly resulting in harassment, injury, or death.

Direct effects to the gartersnake may also occur from heavy machinery working next to the stream bank, crossing the stream, or during excavation activities. Implementing the project during April to May when the gartersnake is surface active provides an opportunity for gartersnakes to escape the adverse effects of heavy machinery. However, if gartersnakes are using the microsites targeted for stream enhancement features, there is the potential of individuals being injured or killed if they are unable to escape from the construction area. Having an AGFD or TNF biologist who is experienced with narrow-headed gartersnake ecology on site during the use of heavy equipment provides the opportunity for any observed gartersnake to be captured and relocated temporarily thereby reducing the chances of gartersnakes being harmed. Additionally, the short duration needed to complete construction and the small project footprint should minimize the amount of time gartersnakes may be at risk of being disturbed or injured during implementation.

Indirect effects to narrow-headed gartersnakes associated with the proposed action may result in short-term adverse effects, and long-term beneficial effects. Temporary alteration of gartersnake habitat would occur. Affected habitat would likely be unsuitable for gartersnakes for up to two weeks during project implementation, resulting in temporary displacement of affected

individuals. There will likely also be a short-term influx of sediment from construction work within the bankfull channel of Haigler Creek. This could result in increased embeddedness of downstream substrates that may adversely impact fish breeding habitat (e.g., longfin dace, desert sucker, and speckled dace) and therefore could adversely affect the prey base for narrow-headed gartersnakes in the short-term. However, the proposed project will also provide long-term benefits to narrow-headed gartersnake and its habitat. We expect the planned improvements to the aquatic habitat and riparian areas will reduce flow rates and improve sinuosity, thereby lessening effects of sedimentation and turbidity. We also expect the enhancements to benefit the native fish species used as prey through improved water quality; channel restoration; and addition of structures that slow stream velocity, reduce erosion, and reduce water temperatures. Over the long-term, revegetation of disturbed areas, and pole and vegetation plantings will help stabilize the banks, reduce sheet erosion and sedimentation, and eventually provide stream bank cover that will create protective cover for the gartersnake.

Effects on Proposed Critical Habitat

The TNF estimates that a total of 10 acres of proposed critical habitat will be temporarily impacted by the project. Stream and stream-side characteristics (PCE 1 and 2) are anticipated to be affected by heavy equipment used to improve instream habitat and to excavate pools and slope banks. Disturbances to PCE 1 and PCE 2 will be short-term and temporary. Construction activities would result in temporary alteration of substrates such as sand, cobble and boulders during structure placement activities (PCE1). Some terrestrial areas adjacent to the stream (PCE 2) will be impacted by soil compaction and ground disturbances associated with heavy equipment use. The contractor would avoid impacts to existing vegetation as much as possible. However, impacts to PCE 2 may also occur due to multiple trips to/from the stream from existing roads or trails. Reseeding, closing of these routes, and smoothing out vehicle tracks will help the shoreline vegetation (PCE 2) recover from any trampling or crushing. The proposed project would result in beneficial effects to PCE 2 through the restoration of shoreline habitat affected by flooding and heavy recreational use. Specifically, native seed distribution, willow plantings, and installation of deer grass plugs on denuded banks and shorelines near heavily used trails would create new habitat features for the gartersnake in the future. No permanent impacts to areas outside the stream channel are anticipated except for the removal of potential long-term cover sites such as boulders.

We expect installation of instream habitat structures and channel work will result in short-term displacement of fish from each of the work sites but that fish will return in response to the habitat improvements. Because the goal of the proposed action is to improve aquatic habitat, any adverse effects to the gartersnake and its proposed critical habitat are expected to be short-term, ultimately benefitting narrow-headed gartersnakes and their prey base over the long-term. This means there will be a short-term adverse effect to PCE 3, followed by a longer-term beneficial effect with improved resiliency within the native fish community. Although brown trout populations may also be enhanced by the changes to stream habitat, we are uncertain whether this action will have any long-term effect to narrow-headed gartersnake proposed critical habitat (PCE 4) for this project.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Future State actions that are reasonably certain to occur are continued stocking of rainbow trout in Haigler Creek. Any adverse effects on the narrow-headed gartersnake that may result from future stocking has been considered in the Statewide and Urban Fisheries Stocking Program consultation and CAMP, which is described in the Environmental Baseline section.

Other activities that are reasonably certain to occur in the action area are the intentional killing of gartersnakes by the public. If the project succeeds in meeting objectives from the habitat improvements, angling use as well as general visitation (i.e., non-angler use) of the area is likely to increase, which increases the potential for adverse interactions of the narrow-headed gartersnakes with humans. The phrase "adverse human interaction" can refer to the act of humans directly injuring or killing snakes out of a sense of fear or anxiety (ophidiophobia), or for no reason whatsoever. Examples are provided by Rosen and Schwalbe (1988) who documented substantial human-caused mortality on narrow-headed gartersnakes at Oak Creek Canyon, a site used heavily by recreationists. Nowak and Santana-Bendix (2002) also reported high rates of direct mortality on narrow-headed gartersnakes at sites within Oak Creek that receive high recreational use (e.g., Slide Rock State Park), but they did not consider the overall impact of recreation on the population to be large.

CONCLUSION

After reviewing the current status of the narrow-headed gartersnake and its proposed critical habitat), the environmental baseline for the action area, the effects of the proposed Haigler Creek Habitat Restoration Project, and the cumulative effects, it is our biological opinion that the construction and installation of the aquatic enhancements, as proposed, are not likely to jeopardize the continued existence of the narrow-headed gartersnake, and are not likely to destroy or adversely modify its proposed critical habitat. We base our conclusion on the following:

- The proposed stream restoration activities will be completed over a short time period resulting in temporary ground disturbance. We expect any individuals that may be present during construction would move out of the project area. The presence of an AGFD or TNF biologist during ground disturbing activities provides an opportunity to reduce or minimize impacts to any observed narrow-headed gartersnakes.
- The proposed project will provide indirect benefits to the narrow-headed gartersnake, including creating new habitat features, establishing streamside vegetation and protective cover, and enhancing its prey base.
- Implementation of the proposed project would not permanently alter any of the PCEs to a degree that would preclude recovery of the narrow-headed gartersnake within the subbasin, and would retain the current ability for the physical and biological features to be functionally reestablished for the narrow-headed gartersnake.

The conclusions of this biological opinion are based on full implementation of the project as described in the Description of the Proposed Action section of this document, including any Conservation Measures that were incorporated into the project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR § 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Forest so that they become binding conditions of any grant or permit issued to the (applicant), as appropriate, for the exemption in section 7(o)(2) to apply. The TNF has a continuing duty to regulate the activity covered by this incidental take statement. If the TNF (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the TNF must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement. [50 CFR § 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

We anticipate that the proposed action is reasonably certain to result in incidental take of the narrow-headed gartersnake. We anticipate the incidental take of up to three narrow-headed gartersnakes in the form of harassment, harm, injury or death from construction activities occurring within its habitat.

Because narrow-headed gartersnakes are difficult to detect, secretive, and use subsurface retreats and protective cover, more narrow-headed gartersnakes may be incidentally taken by the project than can be observed. Therefore, if narrow-headed gartersnakes are being observed during heavy equipment activities associated with the project, there is a possibility narrow-headed gartersnakes are being taken and incidental take may be exceeded. In the case that two narrow-headed gartersnakes are detected during heavy machinery operations, the TNF should contact this office as soon as possible to discuss the activities that are underway and whether consultation reinitiation or additional protective measures are necessary. Similarly, due to the

gartersnake's secretive nature, if two narrow-headed gartersnakes are observed injured or killed as a result of the Haigler Creek Habitat Restoration Project, we will consider the amount or extent of incidental take of three snakes has been reached.

EFFECT OF THE TAKE

In this biological opinion, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat for the reasons stated in the Conclusions section.

REASONABLE AND PRUDENT MEASURES

Reasonable and prudent measures and terms and conditions should minimize the effects of take, and provide monitoring and reporting requirements [50 CFR § 402.14(i)(3)]. We believe the conservation measures and NCD's mitigation measures that are built into the design of the project, as proposed, will adequately minimize the effect of take from this proposed action. With the exception of reporting, we are not recommending additional actions be taken by the Forest.

The following reasonable and prudent measure(s) are necessary and appropriate to minimize take of the narrow-headed gartersnake:

1. The TNF shall minimize and monitor incidental take resulting from the proposed action and report to the FWS the findings of that monitoring.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the (agency) must comply with the following term(s) and condition(s), which implement the reasonable and prudent measure(s) described above and outline required reporting/monitoring requirements. This/these term(s) and condition(s) is/are non-discretionary.

- 1) If a narrow-headed gartersnake is observed during project implementation, the biological monitor shall immediately attempt to relocate the gartersnake to the closest suitable habitat up- or downstream and away from project activity and carefully release it under the cover of a suitable object. If a narrow-headed gartersnake is observed during project implementation, the TNF shall notify us as soon as possible.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS's Law Enforcement Office, 2545 W. Frye Road, Suite 8, Chandler, Arizona 85224 (480) 967-7878) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured

animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. We recommend the TNF work with the AGFD and FWS to improve the diversity, abundance, continuity, and availability of prey species for the narrow-headed gartersnake along Haigler Creek and elsewhere throughout the TNF.
2. We recommend that the TNF and AGFD, in coordination with FWS, seek out opportunities to educate recreationists and pursue their assistance in protecting the narrow-headed gartersnake and its habitat along Haigler Creek and elsewhere throughout the TNF. We recommend collaborative opportunities to educate TNF visitors (possibly with TNF campground hosts, signage, maps, brochures, etc.) on gartersnake natural history, habitat, conservation, threats, and protection of stream improvements.
3. We recommend the TNF work with AGFD and the FWS to develop and implement a monitoring plan to better determine the distribution, abundance, and trends of narrow-headed gartersnake populations on the TNF.
4. We recommend the TNF collaborate with AGFD and the FWS in reducing populations of harmful nonnative aquatic organisms in the Tonto Creek subbasin that prey upon and compete with the narrow-headed gartersnake, particularly bullfrogs, spiny-rayed fish, brown trout, and crayfish.
5. We recommend the TNF participate in the Gartersnake Conservation Working Group by ensuring TNF biologists attend meetings and coordinate in monitoring and recovery planning.
6. We recommend the TNF consider the Erosion Control Fabric Recommendations (Appendix A) to reduce the potential of entanglements of narrow-headed gartersnakes.

In order for the FWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the FWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes the conference for the proposed Haigler Creek Aquatic Habitat Restoration Project. You may ask us to confirm the conference opinion as a biological opinion issued through formal consultation if the proposed critical habitat is designated. The request must be in writing. If we review the proposed action and find there have been no significant changes in the action as planned or in the information used during the conference, we will confirm the conference opinion as the biological opinion for the project and no further section 7 consultation will be necessary.

This concludes formal consultation on the action outlined in your request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Certain project activities may also affect species protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 U.S.C. sec. 703-712) and/or bald and golden eagles protected under the Bald and Golden Eagle Protection Act (Eagle Act). The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the FWS. The Eagle Act prohibits anyone, without a FWS permit, from taking (including disturbing) eagles, and including their parts, nests, or eggs. If you think migratory birds and/or eagles will be affected by this project, we recommend seeking our Technical Assistance to identify available conservation measures that you may be able to incorporate into your project.

For more information regarding the MBTA and Eagle Act, please visit the following websites. More information on the MBTA and available permits can be retrieved from <http://www.fws.gov/migratorybirds> and <http://www.fws.gov/migratorybirds/mbpermits.html>. For information on protections for bald eagles, please refer to the FWS's National Bald Eagle Management Guidelines (72 FR 31156) and regulatory definition of the term "disturb" (72 FR 31132) published in the Federal Register on June 5, 2007 (<http://www.fws.gov/southwest/es/arizona/BaldEagle.htm>), as well as the Conservation Assessment and Strategy for the Bald Eagle in Arizona (SWBEMC.org).

In keeping with our trust responsibilities to American Indian Tribes, we encourage you to coordinate with the Bureau of Indian Affairs in the implementation of this consultation and, by copy of this biological opinion, are notifying the following Tribes of its completion: Tonto Apache Tribe and the White Mountain Apache Tribe. We also encourage you to coordinate the review of this project with the Arizona Game and Fish Department.

We appreciate the TNF's efforts to identify and minimize effects to listed species from this project. Please refer to the consultation number, 002EAAZ00-2012-F-0167-R1 in future correspondence concerning this project. Should you require further assistance or if you have any questions, please contact Kathy Robertson or Greg Beatty at (602) 242-0210.

Sincerely,



 Steven L. Spangle
Field Supervisor

cc (electronic):

Assistant Field Supervisor, Fish and Wildlife Service, Tucson, AZ (Attn: Jeff Servoss)
Fish Biologist, Tonto National Forest, Phoenix, AZ (Attn: Tammy Hoem Neher)
District Biologist, Tonto National Forest, Pleasant Valley, AZ (Attn: Christina Akins)

Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ
Director, Cultural Resource Department, Tonto Apache Tribe, Payson, AZ
(Attn: Wally Davis, Jr.)

Director, Cultural Resources, White Mountain Apache Tribe, Whiteriver, AZ
(Attn: Ramon Riley)

Branch Chief, Environmental Quality Services, Western Regional Office, Bureau of Indian
Affairs, Phoenix, AZ (Attn: Charles Lewis)

LITERATURE CITED

- Barragán-Ramírez, J. L. and J. J. Ascencio-Arrayga. 2013. *Thamnophis eques* (Mexican gartersnake). Mortality. *Herpetological Review* 44(1):158.
- Barton, C. and K. Kinkead. 2005. Do erosion control and snakes mesh? *Journal of Soil and Water Conservation* 60(2):33-35.
- Bonar, S., L. L. Leslie, and C. E. Velez. 2004. Influence of species, size class, environment, and season, on introduced fish predation on native species in the Verde River system, Arizona. Arizona Cooperative Fish and Wildlife Reach Unit, Fisheries Research Report 04-01.
- Boundy, J. 1994. *Thamnophis rufipunctatus*. Color and size. *Herpetological Review* 25(3):126-127.
- Breining, D. R., M. J. Mazerolle, M. R. Bolt, M. L. Legare, J. H. Drese, and J. E. Hines. 2012. Habitation fragmentation effects on annual survival of the federally protected eastern indigo snake. *Animal Conservation* 15:361-368.
- Brennan, T. C. 2007. Collecting narrow-headed gartersnakes (*Thamnophis rufipunctatus*) at the Black River, Arizona. Report submitted to the Arizona Game and Fish Department. 12 pp.
- Brennan, T. C. and A. T. Holycross. 2006. A Field Guide to Amphibians and Reptiles in Arizona. Arizona Game and Fish Department, Phoenix. 150 pp.
- Brennan, T. C. and P. C. Rosen. 2009. Report on narrow-headed gartersnake (*Thamnophis rufipunctatus*) surveys at Oak Creek and the Black River, Arizona. Report submitted to the Arizona Game and Fish Department. 23 pp.
- Brennan, T. C., P. C. Rosen, and L. Hellekson. 2009. *Diadophis punctatus regalis* (regal ring-necked snake) diet. *Sonoran Herpetologist* 22(11): 123.
- Briggs, M.K. 1996. Riparian ecosystem recovery in arid lands. University of Arizona Press, Tucson, Arizona. 159 pp.
- Campbell, K. R., T. S. Campbell, and J. Burger. 2005. Heavy metal concentrations in northern water snakes (*Nerodia sipedon*) from East Fork Poplar Creek and the Little River, East Tennessee, USA. *Archives of Environmental Contamination and Toxicology* 49:239-248.
- Carpenter, J. and J. W. Terrell. 2005. Effectiveness of fish barriers and renovations for maintaining and enhancing populations of native southwestern fishes. Final report to the USFWS Arizona Ecological Services Office. Interagency Agreement Number: 201814N756. CAP Fund Transfer Program Task 4-52. USGS Fort Collins Science Center, Fort Collins, Colorado. 111 pp.

- Christman, B. 2016a. Summary of 2015 monitoring for the narrow-headed gartersnake (*Thamnophis rufipunctatus*), at the Tularosa River, Upper Middle Fork Gila River, Whitewater Creek, and Saliz Creek. Endangered Species Act recovery permit report for 2015 activities, submitted to the U.S. Fish and Wildlife Service's Arizona Ecological Services Office. 6 pp.
- Clarkson, R. W., P. C. Marsh, S. E. Stefferud, and J. A. Stefferud. 2005. Conflicts between native fish and nonnative sport fish management in the southwestern United States. *Fisheries* 30(9):20-27.
- Dawson, V. K., and C. S. Kolar, editors. 2003. Integrated management techniques to control nonnative fishes. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin, December 2003. 146 pp. + appendices.
- Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. *Amphibians and Reptiles of New Mexico*. University of New Mexico Press, Albuquerque. 431 pp.
- de Queiroz, A. 2003. Testing an adaptive hypothesis through context-dependence: effects of water depth on foraging behavior in three species of garter snakes. *Ethology* 109:369-384.
- Desert Fishes Team (DFT). 2003. Status of federal- and state-listed fishes of the Gila River Basin, with recommendations for management. Report Number 1. 19 pp.
- Desert Fishes Team (DFT). 2004. Status of non-listed warm water fishes of the Gila River Basin, with recommendations for management. Report Number 2. 10 pp. (+ Tables).
- Douglas, M. E., P. C. Marsh, and W. L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. *Copeia* (1):9-19.
- Drummond, H. and C. Macías Garcia. 1983. Limitations of a generalist: a field comparison of foraging snakes. *Behaviour* 108(1/2):23-43.
- Ernst C. H. and G. R. Zug. 1996. *Snakes in question*. Smithsonian Institution Press. Washington D. C. 203 pp.
- Ernst, C. H. and E. M. Ernst. 2003. *Snakes of the United States and Canada*. Smithsonian Institution. 668 pp.
- Etzel, K. E., T. C. Theimer, M. J. Johnson, and J. A. Holmes. 2014. Variation in prey delivered to common black-hawk (*Buteogallus anthracinus*) nests in Arizona drainage basins. *Journal of raptor Research* 48(1):54-60.
- Fagan, W. F., C. Aumann, C. M. Kennedy, and P. J. Unmack. 2005. Rarity, fragmentation, and the scale dependence of extinction risk in desert fishes. *Ecology* 86(1):34-41.

- Fernandez, P. J. and P. C. Rosen. 1996. Effects of the introduced crayfish *Orconectes virilis* on native aquatic herpetofauna in Arizona. Report to Heritage Program, Arizona Game and Fish Department, Phoenix. IIPAM Project No. I94054. 57 pp.
- Finlayson, B., R. Schnick, D. Skaar, J. Anderson, L. Demong, D. Duffield, W. Horton, and J. Steinkjer. 2010. Planning and standard operating procedures for the use of rotenone in fish management—rotenone SOP manual. American Fisheries Society, Bethesda, Maryland. 143 pp.
- Fleharty, E. D. 1967. Comparative ecology of *Thamnophis elegans*, *T. cyrtopsis*, and *T. rufipunctatus* in New Mexico. The Southwestern Naturalist 12(3):207-229.
- Gartersnake Conservation Working Group (GCWG). 2016. Northern Mexican and narrow-headed gartersnake 2016 survey results presented at the Gartersnake Conservation Working Group annual meeting December 1-2, 2016. Unpublished report. 8 pp.
- Greene, H. W. 1997. Snakes: The evolution of mystery in nature. University of California Press. Berkley and Los Angeles, California. 351 pp.
- Haney, J., M. Robles, D. Majka, and R. Marshall. 2009. Sustaining river flows in the face of growing water demands in Arizona. Unpublished report from The Nature Conservancy Center for Science and Public Policy. 11 pp.
- Hellekson, L. 2012b. E-mail correspondence from Lyndsay Hellekson (August 29, 2012; 1407 hrs).
- Hibbitts, T. J. and L. A. Fitzgerald. 2005. Morphological and ecological convergence in two natracine snakes. Biological Journal of the Linnean Society 85:363-371.
- Hibbitts, T. J., C. W. Painter, and A. T. Holycross. 2009. Ecology of a population of the narrow-headed garter snake (*Thamnophis rufipunctatus*) in New Mexico: catastrophic decline of a river specialist. The Southwestern Naturalist 54(4):461-467.
- Holycross, A. T., W. P. Burger, E. J. Nigro, and T. C. Brennan. 2006. Surveys for *Thamnophis eques* and *Thamnophis rufipunctatus* along the Mogollon Rim and New Mexico. A report to submitted to the Arizona Game and Fish Department. 94 pp.
- Hopkins, W. A., C. L. Rowe, and J. D. Congdon. 1999. Elevated trace element concentrations and standard metabolic rate in banded water snakes (*Nerodia fasciata*) exposed to coal combustion wastes. Environmental Toxicology and Chemistry 18(6):1259-1263.
- InciWeb. 2011. On-line Incident Information System. Wallow Fire. Available at: <http://www.inciweb.org/incident/2262/>. Accessed on June 22, 2012.
- Inman, T. C., P. C. Marsh, B. E. Bagley, and C. A. Pacey. 1998. Survey of crayfishes of the Gila River basin, Arizona and New Mexico, with notes on occurrences in other Arizona drainages and adjoining States. U.S. Bureau of Reclamation, Phoenix, AZ.

- Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: synthesis report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K., and A. Reisinger (eds.)]. IPCC, Geneva, Switzerland, 52 pp.
- Jennings, R. and B. Christman. 2012. Dry and wet season habitat use of the narrow-headed gartersnake, *Thamnophis rufipunctatus*, in southwestern New Mexico. Final report submitted to Share with Wildlife, New Mexico Department of Game and Fish. 34 pp.
- Kapfer, J. M. and R. A. Paloski. 2011. On the threat to snakes of mesh deployed for erosion control and wildlife exclusion. *Herpetological Conservation and Biology* 6(1):1-9.
- Klauber, L. M. 1956. Rattlesnakes: Their habits, life histories, and influence on mankind. University of California Press. Berkeley and Los Angeles, California. 1,533 pp.
- Knapp, R. A. 2005. Effects of nonnative fish and habitat characteristics on lentic herpetofauna in Yosemite National Park, USA. *Biological Conservation* 121:265-279.
- Ligon, F.K., W.E. Dietrich, and W.J. Trush. 1995. Downstream ecological effects of dams. *BioScience* 45(3):183-192.
- Lopez, M. 2010. E-mail correspondence from Mike Lopez, Fish Program Manager, Arizona Game and Fish Department (January 29, 2010; 1051 hrs.).
- Meffe, G. K. 1985. Predation and species replacement in American Southwestern stream fishes: A case study. *Southwest. Nat.* 30:173-187.
- Meyer, K. 2011. Wallow Fire 2011. Large Scale Event Recovery. Rapid Assessment Team. Fisheries Report. Apache-Sitgreaves National Forests. 21 pp.
- Minckley, W. L. and P. C. March. 2009. Inland fishes of the greater southwest: chronicle of a vanishing biota. University of Arizona Press. Tucson, AZ. 426 pp.
- Mosher, K., A. Makinster, L. Avenetti, A. Vasey, and K. Overton. 2012. Fish and riparian herpetofauna survey: upper Haigler Creek trip report spring 2012. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 18 pp.
- Natural Channel Design (NCD). 2010a. Haigler Creek Aquatic Habitat Assessment. Site Assessment Report. Project #E0075803. Arizona Game and Fish Department, Haigler Creek, Arizona. Prepared by Allen Haden, Natural Channel Design. Submitted to Natalie Robb, Region 6 Fisheries Program, Arizona Game and Fish Department. March 2010. 32pp.
- Natural Channel Design (NCD). 2010b. Haigler Creek Aquatic Habitat Improvement. Design Report. Project #E0078276. USDA Tonto National Forest, Haigler Creek, Arizona. Prepared by Natural Channel Design. Submitted to Natalie Robb, Region 6 Fisheries Program, Arizona Game and Fish Department. June 2010. 16pp.

Natural Channel Design (NCD). 2015. Haigler Creek Aquatic Habitat Enhancement Construction Plans. Arizona Game and Fish Department. Prepared by Natural Channel Design. AGFD Project #E0075803. 13pp.

New Mexico Department of Game and Fish (NMDGF). 2013. New Mexico fishing rules and information: license year 2013-2014. New Mexico Department of Game and Fish; Santa Fe, New Mexico. 25 pp.

Nowak, E. 2006. Monitoring surveys and radio-telemetry of narrow-headed gartersnakes (*Thamnophis rufipunctatus*) in Oak Creek, Arizona. Final Report to the Arizona Game and Fish Department. 40 pp.

Nowak, E. M. 2016b. E-mail correspondence from Erika Nowak (Northern Arizona University). (December 8, 2016; 1230 hrs.).

Nowak, E. M. and M. A. Santana-Bendix. 2002. Status, distribution, and management recommendations for the narrow-headed garter snake (*Thamnophis rufipunctatus*) in Oak Creek, Arizona. Final Report to the Arizona Game and Fish Department. Heritage Grant I99007. 57 pp.

Olden, J. D. and N. L. Poff. 2005. Long-term trends of native and non-native fish faunas in the American Southwest. *Animal Biodiversity and Conservation*, 28(1):75-89.

Ouren, D. H., C. Haas, C. P. Melcher, S. C. Stewart, P. D. Ponds, N. R. Sexton, L. Burris, T. Fancher, and Z. H. Bowen. 2007. Environmental effects of off-highway vehicles on Bureau of Land Management lands: a literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources: U. S. Geological Survey, Open-File Report 2007-1353, 225 pp.

Overpeck, J. 2008. Climate Change in the Southwestern US: Mechanisms, Evidence and Projections. Presented at the New Mexico Climate Change Ecology and Adaptation Workshop. October 22, 2007. Albuquerque, New Mexico.

Painter, C. W. and T. J. Hibbitts. 1996. *Thamnophis rufipunctatus*. Maximum size. *Herpetological Review* 27(3):147.

Paradzick, C, R. Valencia, R. Beane, D. Bills, J. Servoss, B. Werner; and D. Weedman. 2006. Fish and watershed committee report in support of the issuance of an incidental take permit under section 10(a)(1)(B) of the Endangered Species Act: Horseshoe and Bartlett Reservoirs, Verde River, Arizona. 186 pp.

Pilger, T.J., K.B. Gido, and D.L. Propst. 2010. Diet and trophic niche overlap of native and nonnative fishes in the Gila River, USA: Implications for native fish conservation. *Ecology of Freshwater Fish* 19:300-321.

- Propst, D.L. 2002. Systematic investigations of warmwater fish communities. FW-17-RD Completion Report, 1 July 1997 – 30 June 2002. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 18 pp.
- Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spinedace (*Meda fulgida*) in New Mexico. Endangered Species Report Number 15. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 93 pp.
- Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minnow (*Tiaroga cobitis*) in New Mexico. U.S. Fish and Wildlife Service, Endangered Species Report Number 17. 75 pp.
- Propst, D. L., k. B. Gido, and J. A. Stefferud. 2008. Natural flow regimes, nonnative fishes, and native fish persistence in arid-land river systems. *Ecological Applications* 18(5):1236-1252.
- Propst, D.L., Y.M. Paroz, S.M. Carman, and N.D. Zymonas. 2009. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-36, 1 July 2008 – 30 June 2009. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 26 pp.
- Rainwater, T. R., K. D. Reynolds, J. E. Canas, G. P. Cobb, T. A. Anderson, S. T. McMurry, and P. N. Smith. 2005. Organochloride pesticides and mercury in cottonmouths (*Agkistrodon piscivorus*) from northeastern Texas, USA. *Environmental Toxicology and Chemistry* 24(3):665-673.
- Richter, B. D., D. P. Braun, M. A. Mendelson, and L. L. Master. 1997. Threats to imperiled freshwater fauna. *Conservation Biology* 11(5):1081-1093.
- Rinne, J.N., J.A. Stefferud, D.A. Clark, and P.J. Sponholtz. 1998. Fish community structure in the Verde River, Arizona, 1974-1997. *Hydrology and Water Resources in Arizona and the Southwest* 28:75-80.
- Rinne, J.N. 2004. Changes in fish assemblages in the Verde River, Arizona *In* Rinne, Hughes and Calamusso, (Editors) *Changes in large river fish assemblages in North America: Implications for management and sustainability of native species*. AFS-NAJFM special issues.
- Rinne, J.N., C. Carter, and A. Sillas. 2005. Fish assemblages in the upper Verde River: species abundance and interactions with river hydrology, 1994-2005. Flagstaff, Arizona.
- Rosen, P. C. and C. R. Schwalbe. 1988. Status of the Mexican and narrow-headed garter snakes (*Thamnophis eques megalops* and *Thamnophis rufipunctatus rufipunctatus*) in Arizona. Unpubl. report from Arizona Game and Fish Dept. (Phoenix, Arizona) to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. iv + 50 pp + appendices.
- Rossmann, D. A., N. B. Ford, and R. A. Seigel. 1996. *The Garter Snakes*. University of Oklahoma Press: Norman, Oklahoma. 332 pp.

- Seager, R., T. Mingfang, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. *Science* 316:1181-1184.
- Shine, R., M. LeMaster, M. Wall, T. Langkilde, and R. Mason. 2004. Why did the snake cross the road? Effects of roads on movement and location of mates by garter snakes (*Thamnophis sirtalis parietalis*). *Ecology and Society* 9(1):9.
- Stefferd, J.A., K.B. Gido, and D.L. Propst. 2011. Spatially variable response of native fish assemblages to discharge, predators and habitat characteristics in an arid-land river. *Freshwater Biology* 56(7):1403-1416.
- Stromberg, J. C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: the San Pedro River, Arizona. *Ecological Applications* 6(1):113-131.
- Stuart, J. N., M. L. Watson, T. L. Brown, and C. Eustice. 2001. Plastic netting: an entanglement hazard to snakes and other wildlife. *Herpetological Review* 32(3):162-164.
- Timmons, Ross J., S. A. Paulus and L. J. Upton. 2015. Fish monitoring of selected streams within the Gila River Basin, 2014 Annual Report. Annual Report to Bureau of Reclamation, Contract No. R12PC32007. Arizona Game and Fish Department, Nongame Branch, Phoenix, AZ. 51 pp. + Appendices.
- Tonto National Forest (TNF). 2016. Biological Assessment for Haigler Creek Habitat Restoration. Southwest Region. Tonto National Forest, Pleasant Valley Ranger District, Gila County, Arizona. 12 pp.
- Turner, D. S. 2007. Amphibians and reptiles of Sonoita Creek State Natural Area, Arizona. *Sonoran Herpetologist* 20(4):38-42.
- Turner, D. S. and M. D. List. 2007. Habitat mapping and conservation analysis to identify critical streams for Arizona's native fish. *Aquatic conservation: Marine and Freshwater Ecosystems* 17:737-748.
- U.S. Geological Survey (USGS). 2013. Understanding and managing the effects of groundwater pumping on streamflow. Fact Sheet 2013-3001. 3 pp.
- Vasey, A., A. Makinster, L. Avenetti, K. Mosher, C. Gill, W. Burger, and G. Pearce. 2012. Lower Haigler Creek fish and riparian herpetofauna survey: June 12-14, 2012. Arizona Game and Fish Department. 9 pp.
- Voeltz, J. B. 2002. Roundtail chub (*Gila robusta*) status survey of the lower Colorado River basin. Arizona Game and Fish Department, Phoenix, AZ.
- Waters, T.F. 1995. Sediment in streams. Sources, biological effects and control. American Fisheries Society, Monograph 7. Bethesda, MD. 251 pp.

Wheeler, A. P. P. L. Angermeier, and A. E. Rosenberger. 2005. Impacts of new highways and subsequent urbanization on stream habitat and biota. *Reviews in Fisheries Science* (13):141-164.

Wilcox, J. 2015. E-mail correspondence from John Wilcox, Zone Biologist, Payson and Pleasant Valley Ranger Districts, Tonto National Forest (December 4, 2015; 1532 hrs).

Wylie, G. D., R. L. Hothem, D. R. Bergen, L. L. Martin, R. J. Taylor, and B. E. Brussee. 2009. Metals and trace elements in giant gartersnakes (*Thamnophis gigas*) from the Sacramento Valley, California, USA. *Archives of Environmental Contaminant Toxicology* 56:577-587.

Appendix A: Recommendations for Use of Erosion Control Fabric

Loose-weave netting – Use erosion control products which have movable (not fixed or welded) joints between the horizontal and vertical twines, thus allowing the twines to move independently which reduces the likelihood of a gartersnake becoming entangled. Netting designs with movable joints may be called loose weave, leno weave, or gauze weave.

Mesh Size – Avoid using products with a mesh size of 0.5 inch square; this mesh size have the highest likelihood of snake entanglement. Instead, consider larger mesh sizes (3 x 3, 3 x 4, or 1.7 x 0.8 inches), or rectangular meshes with a smaller, ¼-inch aperture in one direction (1.25 x 0.25 inches) which are less prone to snake entanglements.

Natural-Fiber Materials – Use biodegradable, natural-fiber products (including netting, filling, and thread) are more wildlife-friendly than synthetic plastic products which allow entangles snakes a better opportunity to escape because of their lower tensile strength.

Products without Netting – There are several choices of erosion and sediment control products that do not contain netting. These include net-less erosion control blankets (for example, made of excelsior), loose mulch, hydraulic mulch, soil binders, unreinforced silt fences, and straw bales. Net-less erosion control products do not risk entanglement of gartersnakes.

Prompt Removal of Products – Remove erosion control products promptly after they have served their purpose to lessen the risk of gartersnake entanglement.